



Robotic Vehicle Power System Design

Mission-Based Approach

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
for the United States Department of Energy under contract DE-AC04-94AL85000.



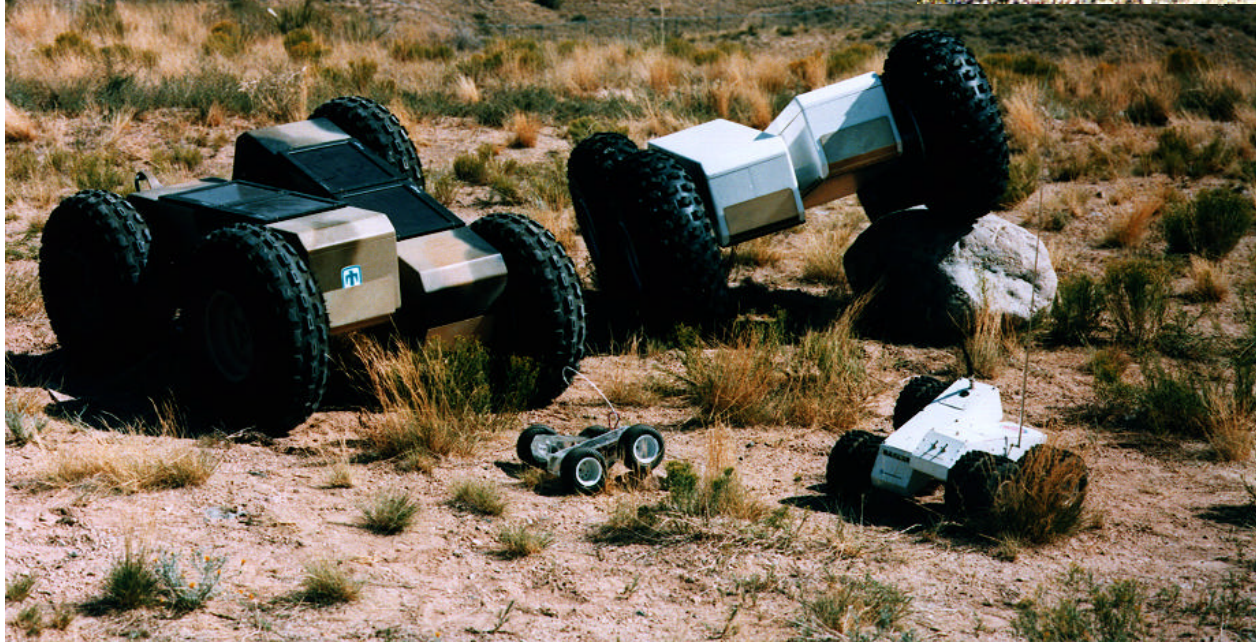


Robotic Vehicle Power Systems Must Support Mission Profiles

- Historically, power systems were selected to demonstrate vehicle capabilities.
 - Future vehicle design must support mission operational profiles. This requires:
 - Knowledge of vehicle power/energy requirements vs. mission terrain.
 - Knowledge of power/energy capabilities of potential vehicle power systems.
- ⇒ Mapping power system capabilities to vehicle mission requirements so the optimal system can be selected.



Some of Sandia's robotic vehicles



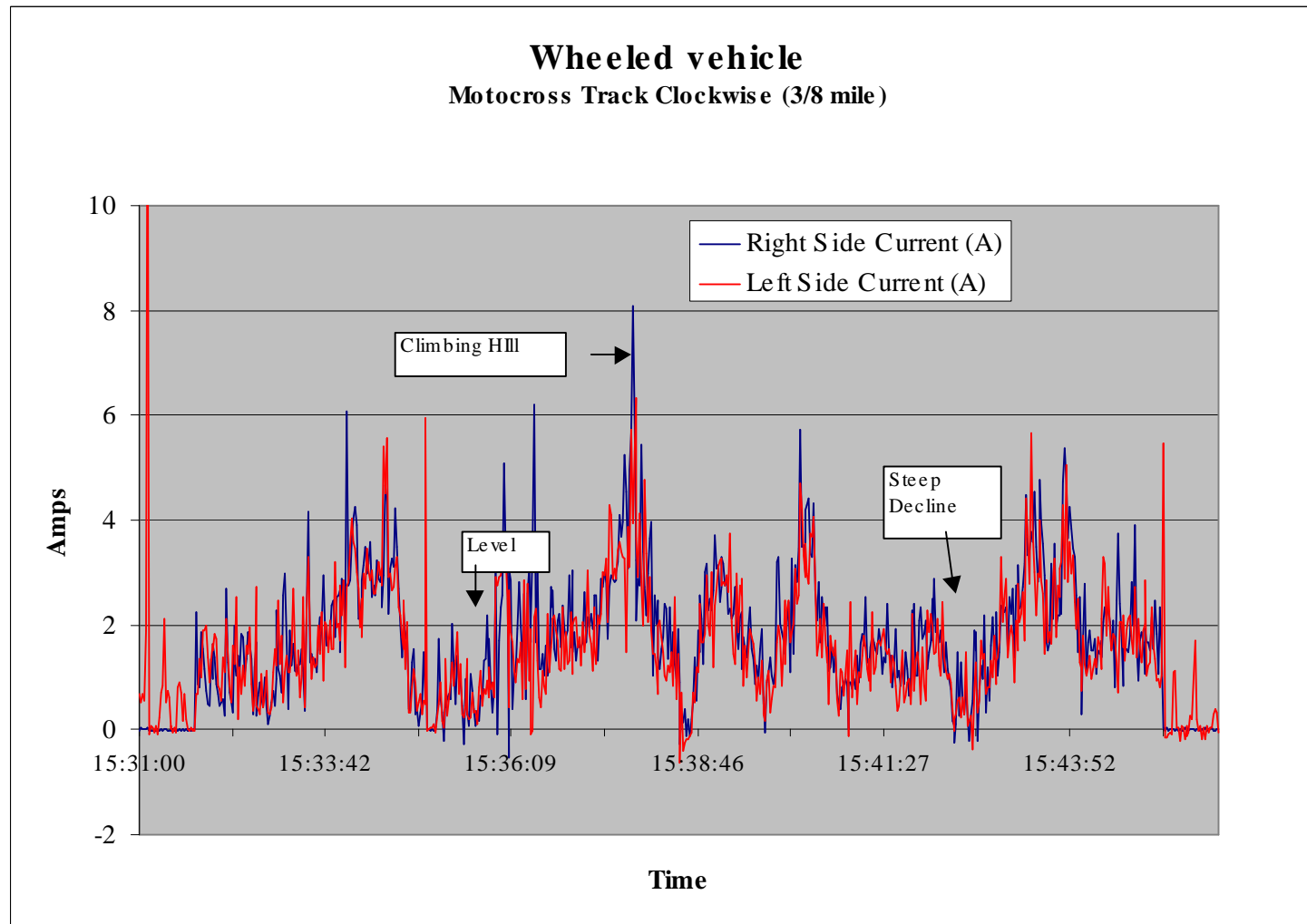
↑
Marvin

↙
Lurch

←
**RATLER
family**



Vehicle Power/Energy Requirements: Test on Hilly Course





Observations on Vehicle Power/Energy Requirements:

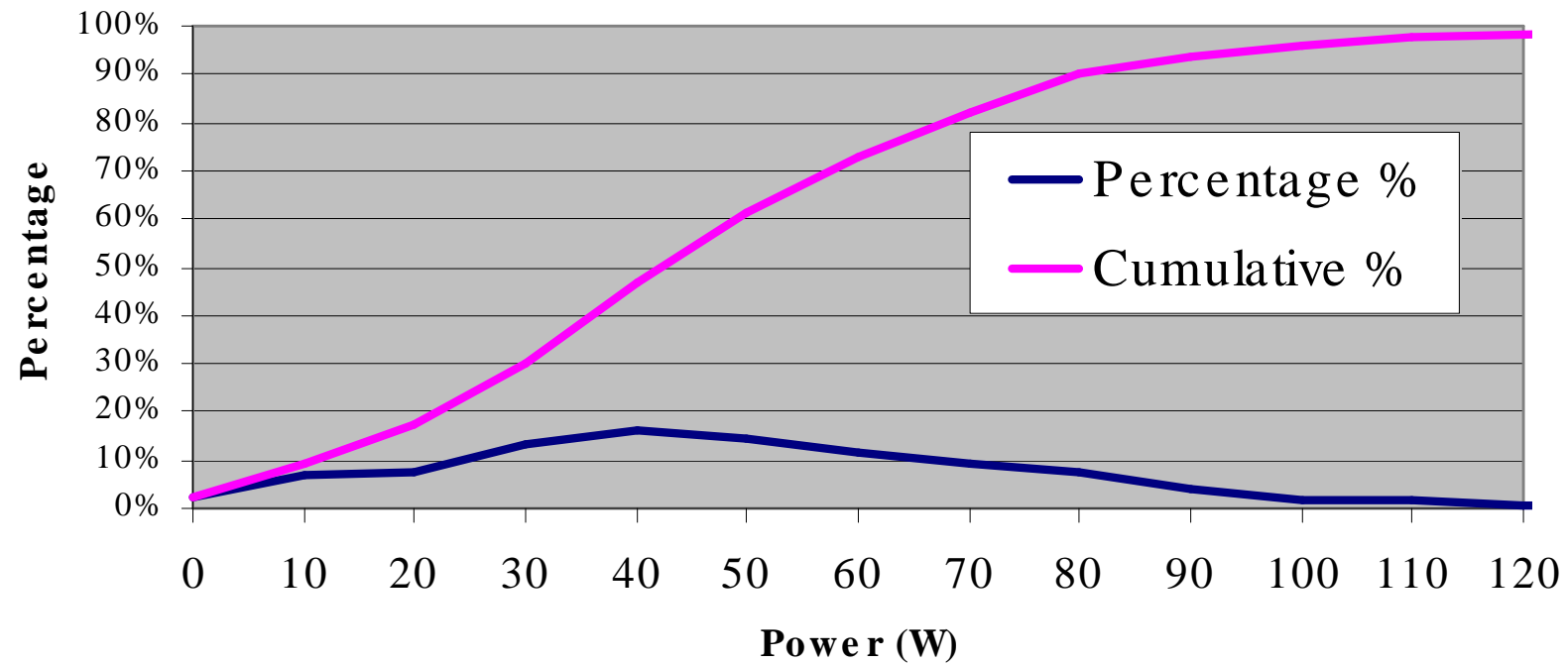
Vehicle operating conditions are challenging:

- Drive motor requirements dominate power specifications, requiring up to 10A under high load conditions.
- Drive current is quite dynamic, varying with terrain (hills and valleys) and even on level ground.
- The demand for smaller vehicles and longer missions puts a premium on high energy density storage.

Both power and energy considerations are crucial!

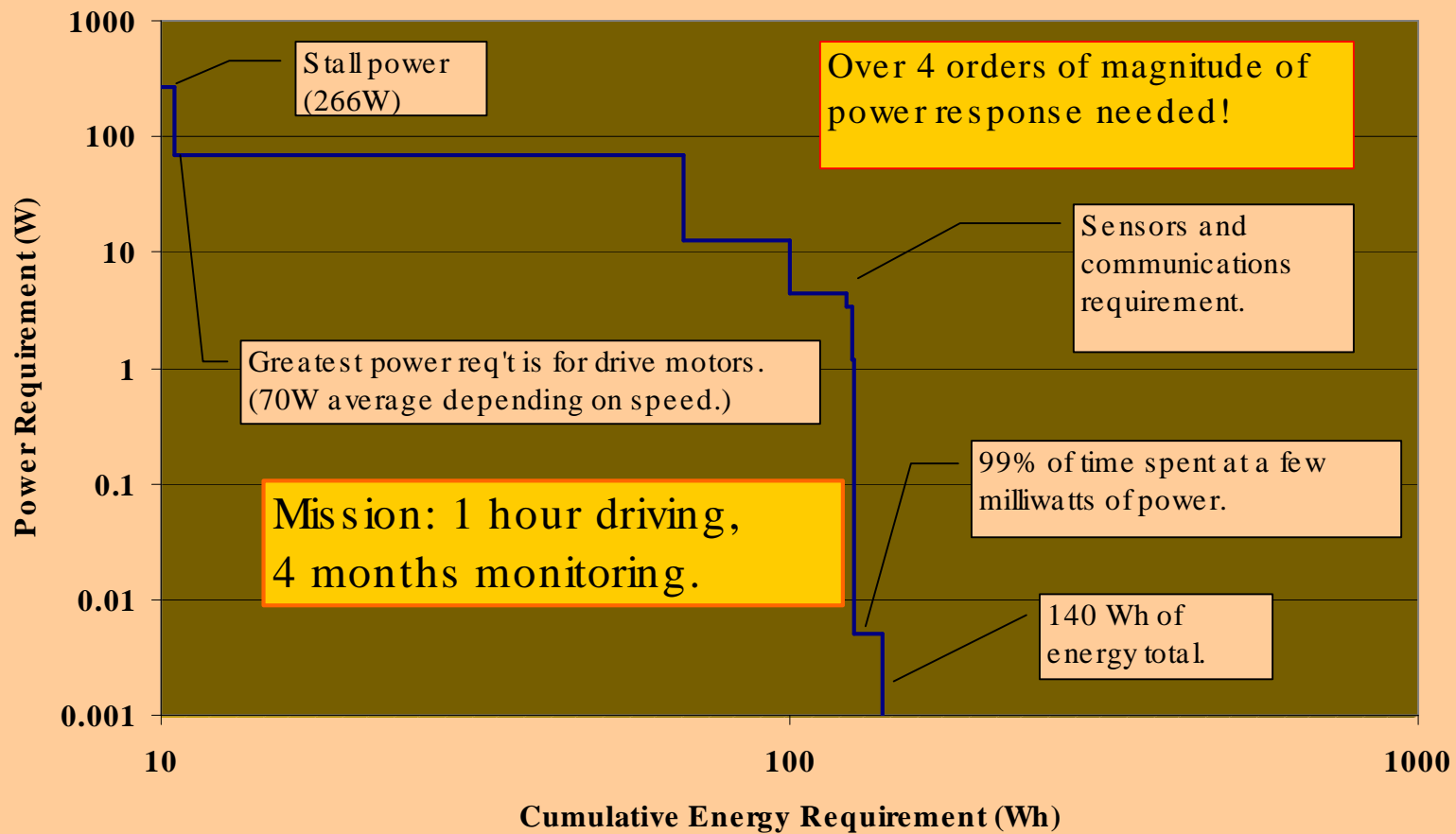


Distribution of Drive Motor Power Requirements While Driving



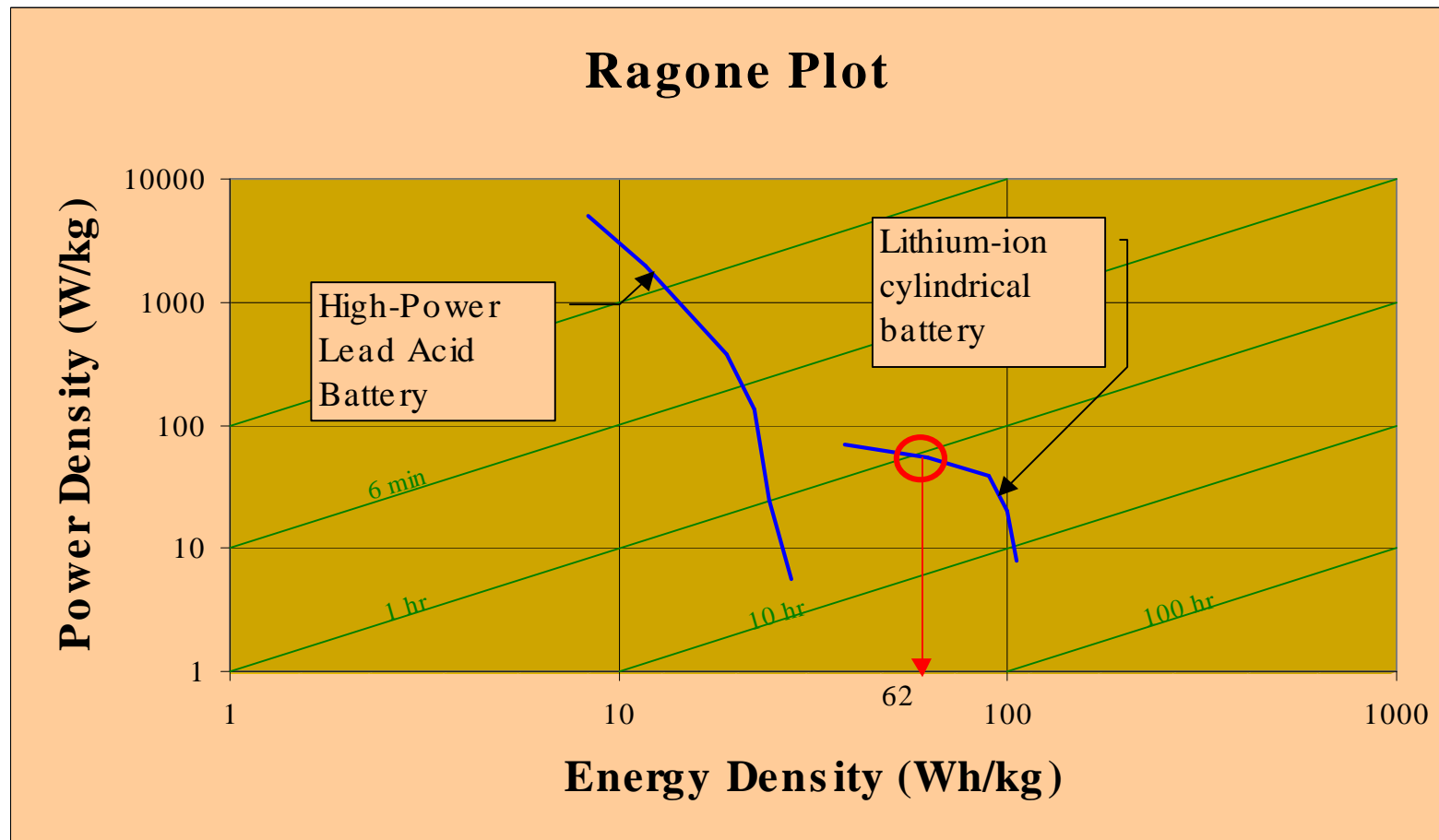


Vehicle Power/Energy Requirements

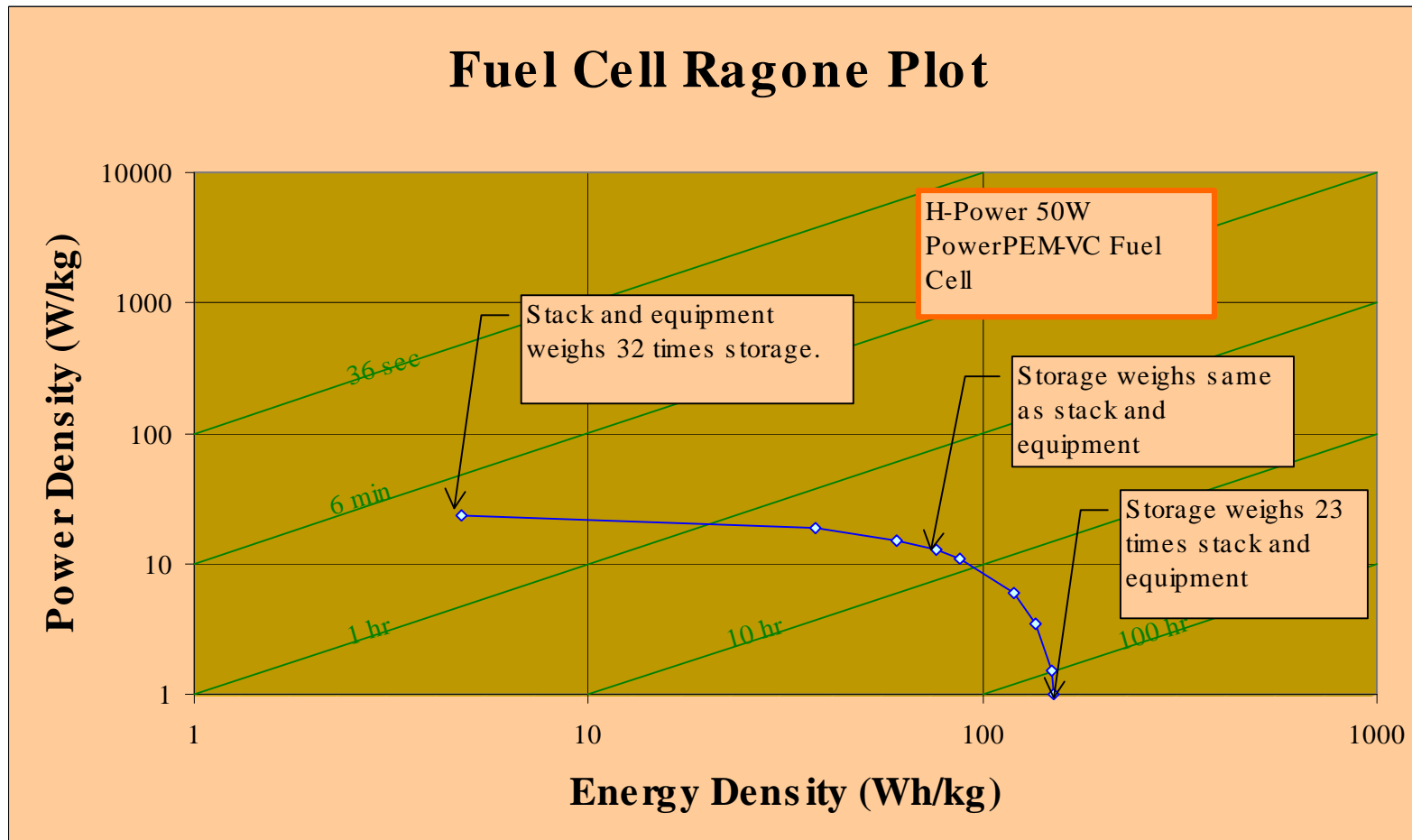




Ragone plots display energy density as a function of power density

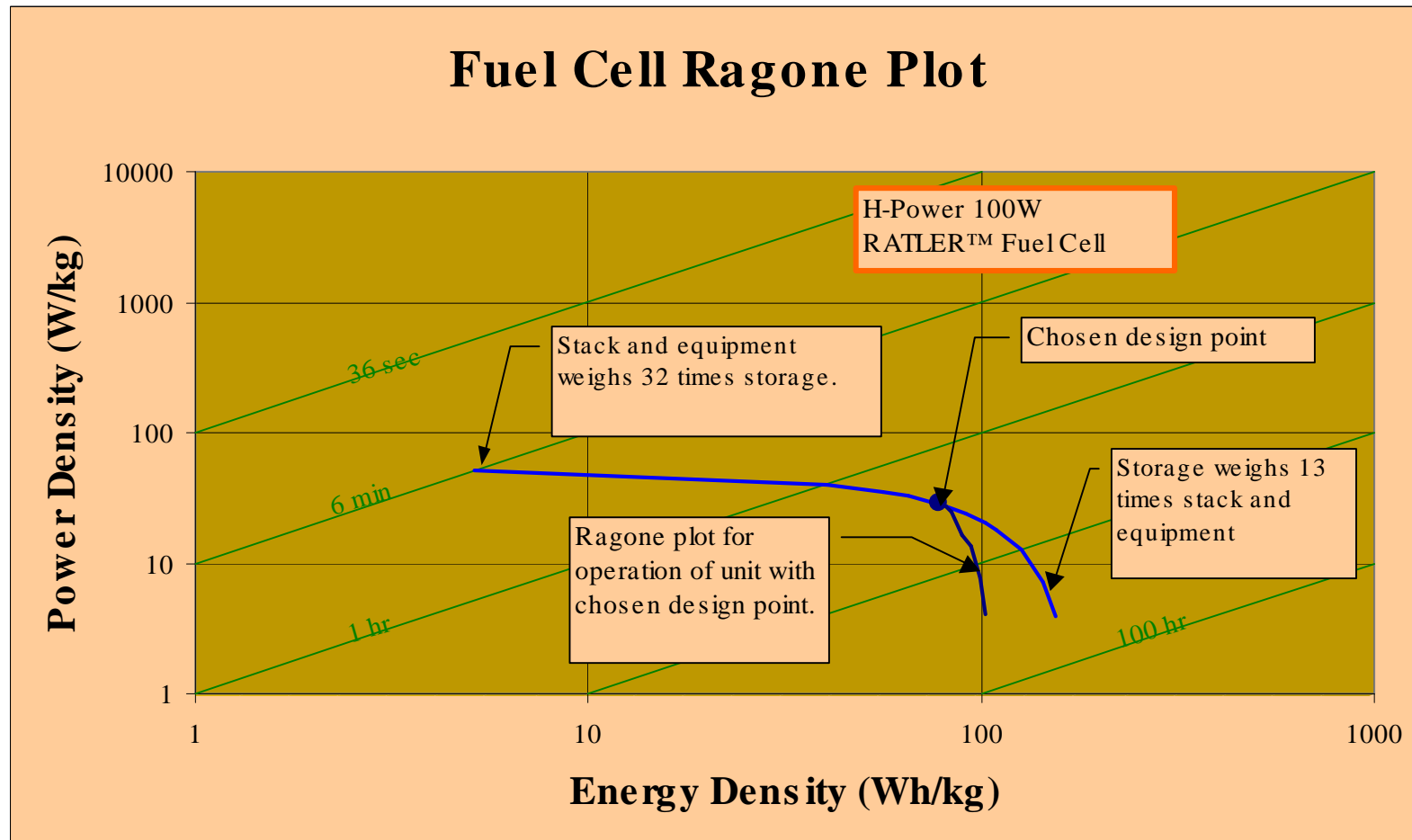


Ragone plot used with a technology having separate generation and storage



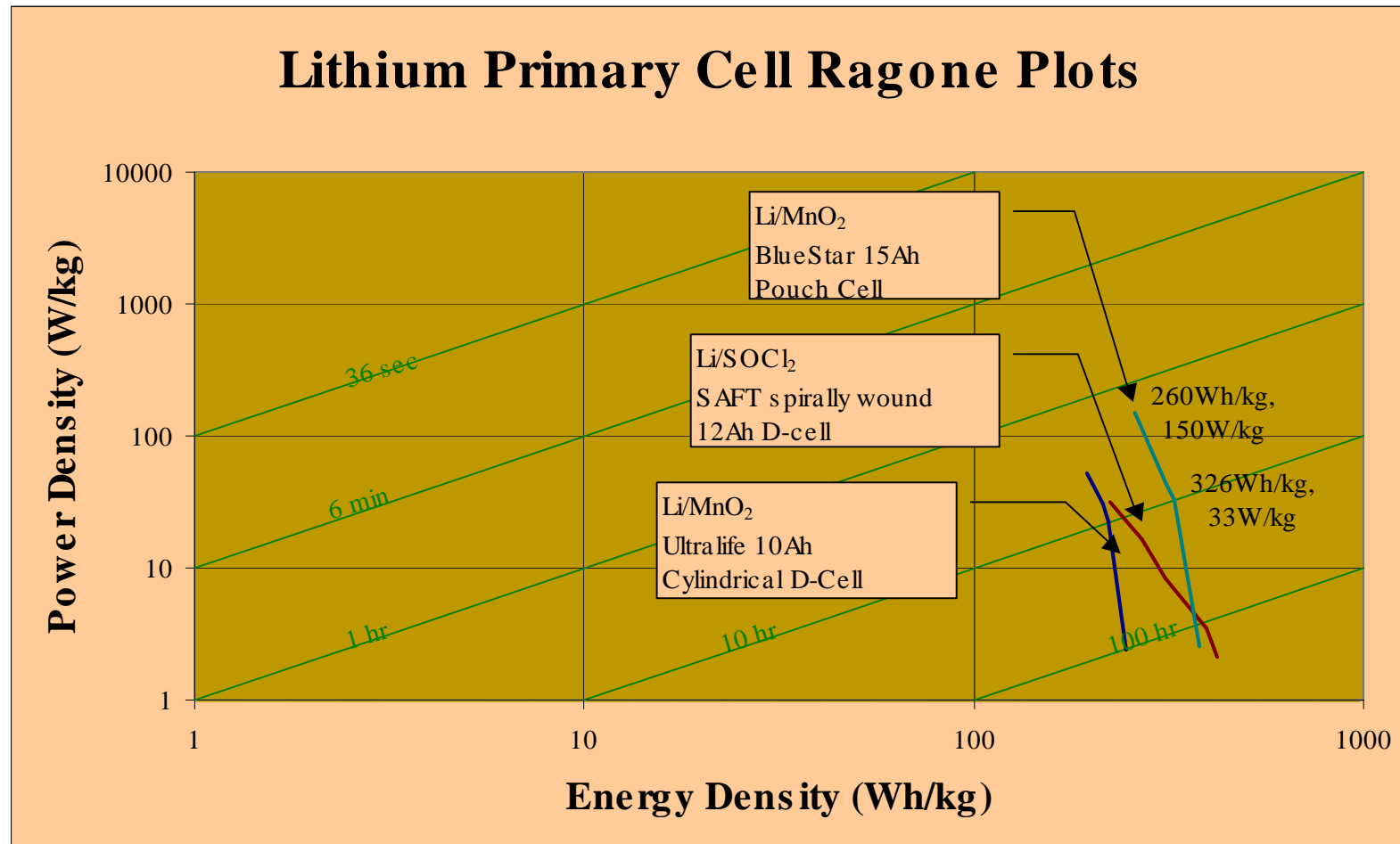


Operational Ragone plot for chosen design point

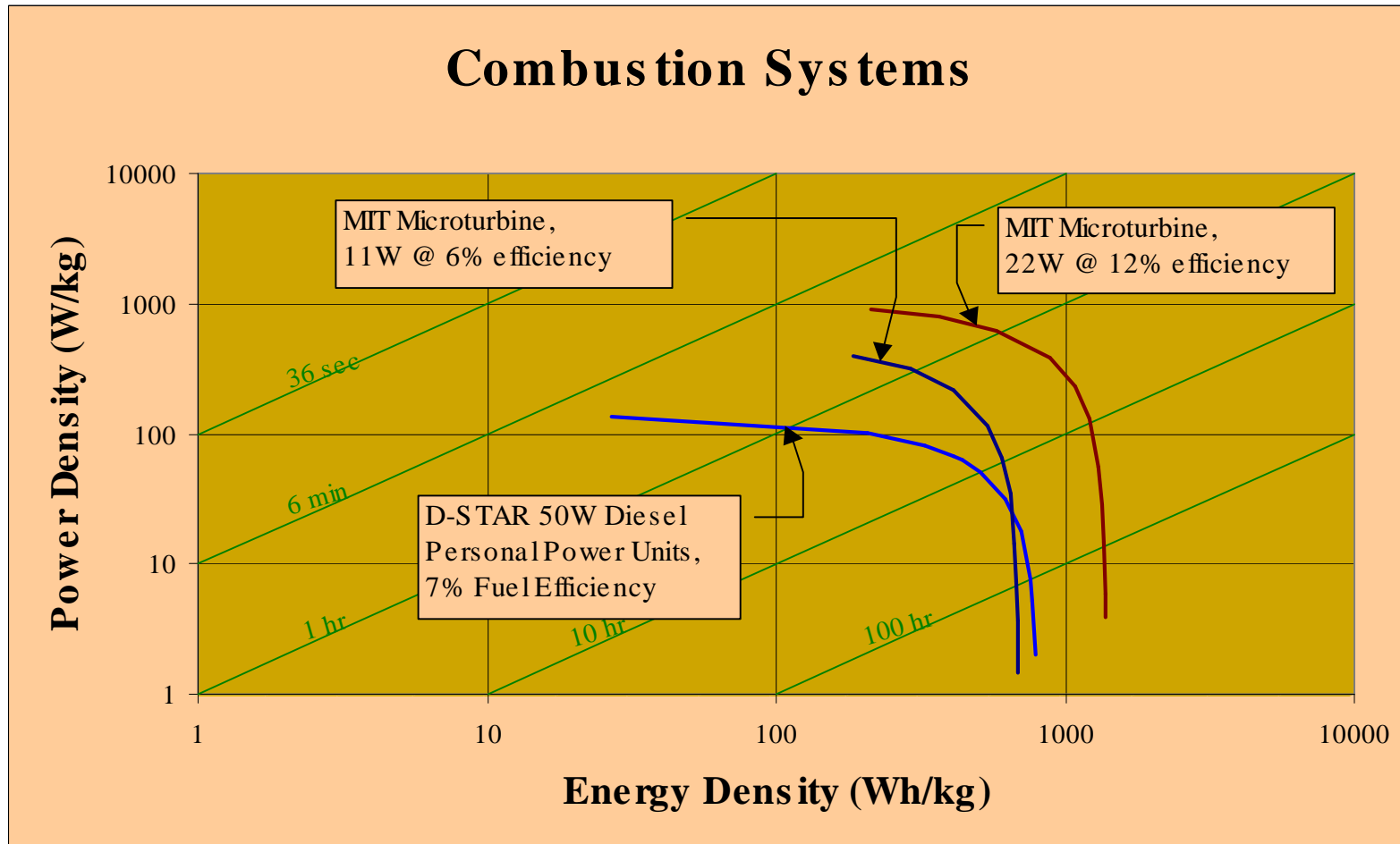




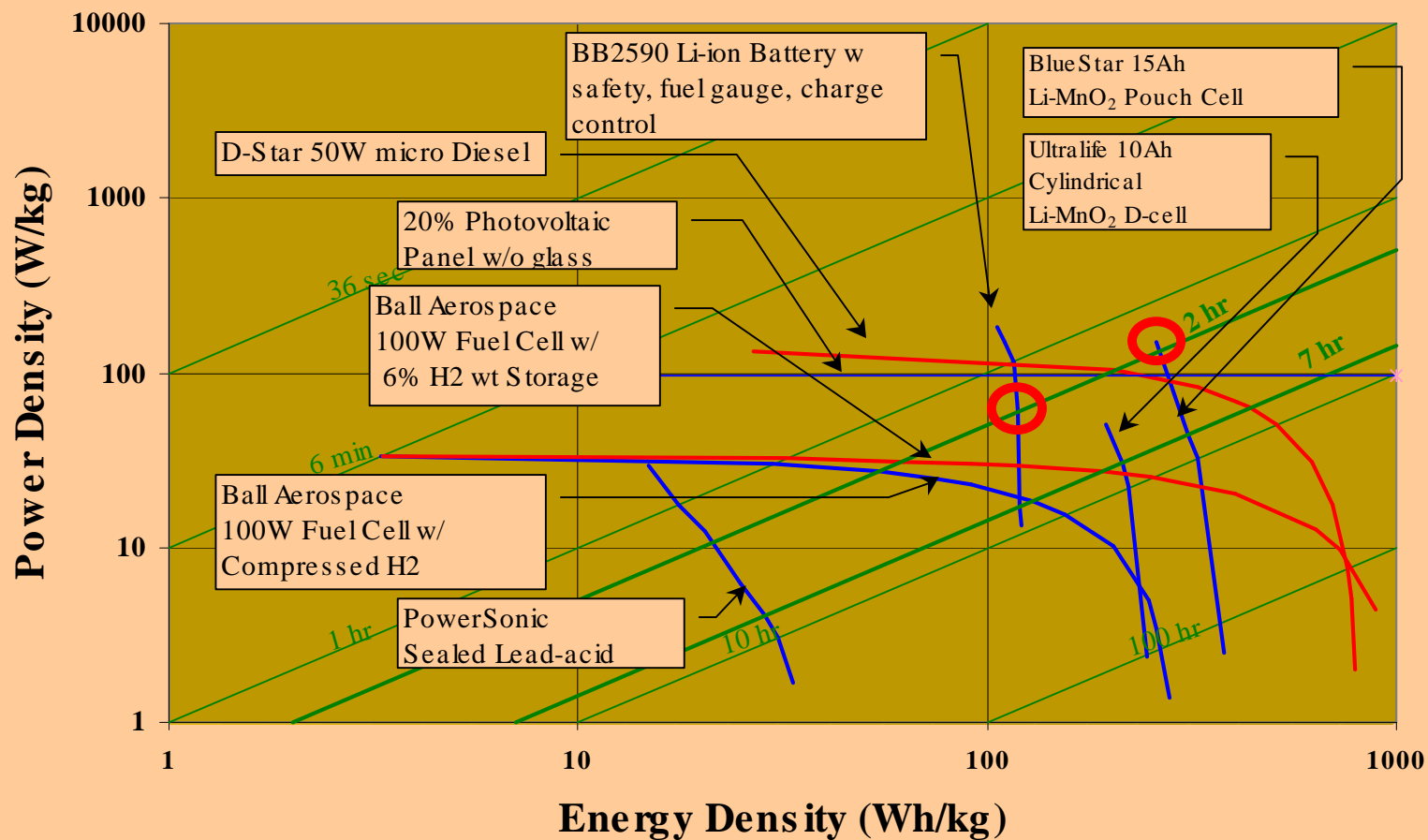
Battery chemistries differ in their power capabilities

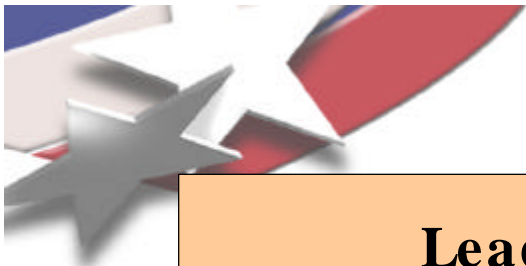


Micro-combustion systems show great promise for high energy density



Leading Vehicle Power System Options





Leading Vehicle Power System Options

